FY 2013 Region 1 Refuge I&M Proposal Template

Submitted by: Eben Paxton, Avian Ecologist, USGS Pacific Island Ecosystems Research Center and Steve Kendall, Wildlife Biologist, Hakalau Forest National Wildlife Refuge

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Project title: Demographic research on Hakalau Forest NWR's forest birds

Primary individual responsible for completing the project (name, title, contact information): Eben Paxton (contact information above)

Project abstract: Hakalau Forest National Wildlife Refuge (Hakalau) is a critical stronghold for endangered Hawaiian forest birds. Long-term trends of native forest birds at Hakalau have been steady or increasing (Camp et al. 2010), reflecting positive responses to management actions, but populations across the island of Hawai'i are overall trending downward (Gorresen et al. 2009) and recent (1999-2007) population trends for several species at Hakalau also indicate a downward trend (Camp et al. 2010). Population dynamics and trends are driven by a population's vital rates: survival, reproduction, and movement (immigration and emigration). Factors that influence the vital rates of birds include their environment (both biotic and abiotic), availability of habitat and other resources, scales of movement, and exposure to disease. Surveys provide information on population trends, but do not inform us on the factors driving these trends. Only by monitoring a population's vital rates can we understand factors influencing trends and have the ability to detect changes in populations that may require management intervention. If survival and reproductive rates are found to be lower than sustainable for a species, further investigations could be initiated to determine what factors (e.g., interspecific competition, disease, parasites, predation, or habitat quality) are responsible. Managers can use this information to implement actions to mitigate threats and assess the effectiveness of such management actions on vital rates to develop an adaptive management approach.

Funding Priorities (check all funding priorities that apply to the project):

X	Inventory Project/Collection of Baseline Data	**X**	Adaptive Management
X	Data Compilation and Management	**X**	Protocol Development
☐	Purchase of Equipment	**X**	Evaluate effects of environmental stressors, incl. climate change
X	Leveraging existing programs supporting surveys on refuges.		

Project objective(s): The objectives of this study are to directly measure vital rates (survivorship and productivity) and condition of native Hawaiian forest birds at Hakalau Forest NWR through banding mark/recapture efforts and nest searching and monitoring, with an emphasis on identifying factors influencing such vital rates (e.g., elevation, habitat structure, disease, management activities). Second, evaluate whether the vital rates are at sufficient levels to ensure

native bird's long-term viability. Current and historical estimates of vital rates will be used to create demographic models which will help us understand and identify factors driving population trends.

Describe how project deliverable(s) will be used by the refuge staff for decision making: Hakalau Forest NWR was created to protect forest birds and their habitats. Refuge staff need information on factors influencing the status of birds to develop effective management actions required to meet this mission. Ongoing efforts to incorporate demographic information directly into the decision making process, include determining management actions to respond to the impacts of climate change (Paxton et al 2011) and development of Hakalau specific demographic models to evaluate potential threats and the effectiveness of management actions.

Methods: Research will be conducted at Hakalau which is located on the windward slopes of Mauna Kea on the island of Hawaii. The refuge supports a high diversity of native plants, invertebrates, and birds, including three endangered bird species (Akepa [*Loxops coccineus*], Akiapola'au [*Hemignathus munroi*], and Hawaii Creeper [*Oreomystis mana*]), and a fourth species under consideration for listing, the I'iwi (*Vestiaria coccinea*). In 2012, a pilot study at Hakalau was successfully conducted to refine research protocols, establish 3 long-term banding sites and create a cohort of banded birds (nearly 500 birds were banded). The 3 banding sites are at different elevations and in different habitats, ranging from large tree closed-canopy forest to young reforested pastures, which will allow for comparison of demographic rates as a function of elevation and habitat. This proposal will support this ongoing project by adding productivity monitoring.

Banding will be conducted from February-April, the best period for capturing birds (USGS unpublished data). At each site we will deploy 10-12 mist nets at fixed locations. Each station will be operated for 2-3 days every two-weeks during the banding period (6 sampling periods per site per year, or approximately 12-18 days of banding per site). Each captured bird will be banded with a metal band and a unique combination of color bands. Standard morphological measurements will be taken (wing length, tail length, bill length and width, fat scores, and molt patterns). Additionally, data collected on body condition (fat, molting patterns, feather condition, body condition indexes) will be used to assess individual bird health (Freed and Cann 2012; Labocha and Hayes 2011). Systematic re-sighting efforts will be made to increase detection probabilities, and thus improve the accuracy of survival and recruitment estimates.

Nest monitoring will be conducted concurrent with banding efforts. At each banding site, systematic searches for nesting birds will be conducted. Observers will walk standard transects at least twice every 2 weeks to search for nests and observe nesting behavior in adult birds. Once nests are located they will be monitored by visual inspection from afar with binoculars or spotting scope. Most nests are located high in trees, and monitoring will involve observing adults visiting nests for incubation or feeding young. Nests will be monitored once every 4 days until no longer active. Data gathered will include attributes of nest location (e.g., height, tree species, distance from canopy top), activity at the nests, and outcome (failed, successful, number young fledged). If a nest is believed to have fledged young, the area will be searched for fledglings to confirm success and count. If the number of nests found exceeds our ability to monitor all nests, then systematic nest searches will continue, but a subset of nests (randomly chosen) will be closely monitored for productivity.

Banding and nest monitoring provides several complementary sources of information that allows us to assess population vital rates and the condition of individuals. Reencounters of banded birds, either through recaptures or visual re-sighting, will provide mark-recapture data that will be analyzed in Program MARK (White et al. 1999) to derive estimates of apparent survivorship and recruitment rates. Program MARK also allows us to analyze nest monitoring data to determine nest survivorship (i.e., Mayfield Method). Importantly, Program MARK allows us to relate both survivorship and nest productivity estimates to covariates such as habitat, elevation, year, species, and age to estimate the importance of these various factors on the population vital rates. Model selection methods (e.g., AIC) will be used to determine the relative importance of covariates on survival and nest success.

Concurrent with these efforts we will develop of demographic models of Hakalau Forest birds (currently funded). Integrated Population Models (IPMs) will be used to link three extensive datasets collected at Hakalau: census data (Camp et al. 2010), and productivity and mark-recapture data from a USGS demographic study in the refuge 1994-1999 (Woodworth et al. 2001; USGS, unpublished data). The advantages of using IPMs is that they utilize all available information, providing more precise parameter estimates, ability to estimate unmeasured demographic parameters (e.g., immigration), and incorporates all sources of uncertainty into final models (Schaub and Abadi 2011). The IPM demographic model will then be used to compare past and present vital rates to assess any significant changes. Finally, the IPMs will form the foundation of a Population Viability Monitoring (PVM; Bakker and Doak 2008) model that will utilize data from banding and census surveys each year to estimate changes in population viability as a function of changes in vital rates and census numbers. This early-warning system approach will be a valuable tool for Refuge managers to monitor population health and allow for rapid management intervention if the need arises.

All necessary permits have been acquired: Bird Banding permit (23604); USFWS Threatened and Endangered Species Permit (TE003483-28); State Wildlife Permit (WL13-07-1); Hakalau Forest Special Use Permit (SUP 12516-12011); and University of Hawaii Institutional of Animal Care and Use Protocol (09-893-3).

Describe any statistical assistance, GIS, or database support needed: USGS PIERC has a GIS and statistics support staff and does not require additional assistance.

Project implementation timeline: Banding and nest monitoring at Hakalau will be conducted Feb-May 2013 and 2014. Data will be entered and proofed by field staff as field season progresses into a standard Access database. A progress report will be completed and submitted by the end of fiscal year 2013, and a final report will be completed by the end of calendar year 2014. IPM modeling of historic demographic data will be completed in 2013, and the PVM model will be completed in 2014; full integration of the models and this demographic study data will be achieved by 2015.

Project completion date: This request is for 2 years of support. Two years are required to have an estimate of yearly variation in productivity, and two additional years of banding along with the 2012 spring banding will allow for estimates of survivorship. After the second season, analysis of field data will be conducted to derive estimates of survival rates and productivity, with a manuscript describing the demographic parameters of Hakalau Forest will be written and

submitted for publication by the end of the calendar year. Integration of data collected for this study into the PVM will also be completed by the end of 2015.

Briefly describe how the project will address each of the following Evaluation Criteria:

1. **Planning Connection –** This project is directly tied to multiple objectives of the Hakalau Forest CCP, including partnering projects identified in Appendix C –"Population Dynamics and Viability of Akepa and Other Species" and "Avian Disease Distribution and Climate Change". It also addresses Goal 6, Objective 6.2: "Conduct High Priority Research Projects that Provide the Best Science for Habitat and Wildlife Management…".
2. **Large Investment in Management Actions –** Conservation of Hawaiian forest birds is a central mandate for Hakalau Forest NWR and most management actions at the refuge are directed at that goal. This project will provide vital information about factors influencing forest bird populations and is key for implementing informed management decisions.
3. **Partners –** This project is a direct collaboration between Hakalau Forest NWR (Kendall) and USGS Pacific Islands Ecosystems Research Center (Paxton) and University of Hawaii Hilo (Dr. Pat Hart). In addition, the information gathered is of great interest to the USFWS Endangered Species Program (3 endangered species and 1 potential listed species); Migratory Bird Program (funded portions of the initial banding project) and Inventory and Monitoring Program (funded analysis of census survey data, a key component of IPM and PVM models).
4. **Controversy –** Hakalau Forest NWR had been subjected to intense controversy by some over understanding of factors affecting forest bird populations, the viability of these populations and management actions that have been implemented. This work provides information critical to understanding status of forest birds and the effectiveness of management actions.
5. **National I&M Priority –** This project addresses several national I&M priorities, including compiling legacy data that supports the refuge's CCP; directly benefits endangered species; direct benefit to the documentation of bird phenology through the field work; and direct benefit to biotic inventories.
6. **Project Design –** We believe this proposal clearly defines the project's objectives, and how they will help refuge management decisions as much as possible in the limited space allowed. A comprehensive description of study design and methods are available upon request. We propose to use commonly implemented, but state of the art methods for data collection, data analysis and model development and believe the project is highly feasible.
7. **Data Management (Complete the next section) –** Project fully addresses data management elements described in RFP (see below), and copies of all data and products will be made available to Region 1 I & M.
8. **Continuity –** This is a new project, but >15 years of previously collected census and demographic research data will incorporated to evaluate long-term changes.
9. **Other Evaluation Criteria –** This project will contribute to multiple peer-review publications, including a paper specifically on the demographic rates, as well as form the basis of demographic models that are applied to conservation issues; second, this project is leveraged with USGS funding to ensure high quality data; and third, banding efforts at

Hakalau host youth environmental education groups approximately once a month to provide education opportunities to a diverse set of children from the surrounding communities.

Briefly describe how the project will address each of the following elements of a Data management plan (See Appendix 1 in the RFP for definitions and examples):

- **Description –** Gather estimates of demographic parameters
- **Data Management Budget –** (~ 5-10% of technician's time will be dedicated to data entry, quality control, and archiving data. 5% of Paxton's time will be in development of database and ensuring proper archiving to match federal data archive requirements.
- **Format –** Microsoft Access.
- **Data Processing and Workflows –** Collected data is entered into a custom-built database; after entry 2 technicians compare written datasheets with entered data to proof, as well as check input to ensure biologically sound measurements; following completion of field season, data is added to central database and placed on USGS server where backups are conducted daily.
- **Quality Checks –** All entered data is checked against original data forms to ensure no editing errors, and a set of standard data proofing routines are used to detect erroneous data. By having technicians enter data, any issues with interpretation of written data forms should be resolved.
- **Back-up and Storage –** All data is stored on USGS servers which are backed-up daily. All Federal Government data archive protocols are followed to ensure long-term availability of data.
- **Metadata –** Metadata will comply with FGDC format
- **Restrictions –** Not for public release until peer-review publications are submitted or 3 years from the end of the project have elapse, whichever is soonest.
- **Contact –** Eben Paxton, USGS Pacific Island Ecosystems Research Center, 808-985-6423, epaxton@usgs.gov

This proposal requests $39,412 for FY13 and $40,408 (3% adjustment for inflation) for FY14, or a total of $79,820 for the two years. Requested funds are for seasonal field technicians (4), per diem, and field housing only. This proposal is highly leveraged, with $155,582 contributed by USGS (PI salary, additional field personnel, vehicles, housing, and all equipment), $43,427 from Hakalau Forest NWR (PI salary, Americorp interns, vehicle, equipment), and $52,012 from collaborating University of Hawaii Hilo (Dr Hart salary, graduate student, housing). An additional $90,000 (USGS funds) is dedicated for producing Hakalau forest bird demographics that will use the data collected from this study to develop PVMs. Detailed budget available on request.

Item	FY13	FY14
Contracts	39,412	40,408
Materials/Equipment		
FWS Personnel Costs		
Other (specify):		
FY TOTAL(S)	39,412	40,408